

KNOWING WHEN TO SAY WHEN: A SIMPLE ASSESSMENT OF ALCOHOL IMPAIRMENT

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The use of writing samples as indices of alcohol impairment was explored. Students at a campus fraternity party wrote a sentence and their signatures before and after consuming alcohol (in beer and mixed drinks). Later, undergraduate and graduate students attempted to discriminate between pre- and postparty handwriting samples. The average percentage of correct discriminations of entrance and exit writing samples was 83.7% for sentences and 67.5% for signatures, and the percentage of correct discriminations increased directly with the blood alcohol concentration of the partier who gave the writing sample. When a partier's blood alcohol concentration reached 0.15, all of the judges accurately discriminated 90% or more of the sentences, and 25 of the 28 judges correctly discriminated at least 80% of the signatures. All of the judges correctly discriminated at least 90% of the 18 sentences written by partiers with a blood alcohol concentration of 0.12 or more. Implications of these findings for reducing the risk of driving while intoxicated are discussed, as well as directions for follow-up research.

DESCRIPTORS: driving behavior, alcohol-impaired driving, blood alcohol concentration, intervention, assessment

As the Number 1 killer of young people in America (NHTSA, 1988), alcohol-impaired driving is a most significant public health problem. In fact, from 1982 through 1986 about 119,000 people were involved in alcohol-related traffic deaths, which averages to one alcohol-related fatality every 22 min for 5 years (Perrine, Peck, & Fell, 1988). The typical approach to deterring driving while intoxicated (DWI) has been to apply punitive strategies. It is estimated, however, that only 1 in 500 to 1 in 2,000 drivers on the road who are legally drunk (i.e., a blood alcohol concentration or BAC of 0.10% or higher) are arrested for DWI (Presidential Commission, 1983).

In recent years, some gains in deterring DWI have occurred as a result of increased public awareness of the consequences of DWI, publicity by advocacy groups such as MADD (Mothers Against

Drunk Drivers), strengthened state and local law enforcement, and an increase in the maximum drinking age (Fell & Klein, 1986). Unfortunately, the overall impact of these efforts has not been overwhelming. For example, alcohol-related traffic fatalities declined only 11% between 1982 and 1985 (NHTSA, 1987). According to recent research reviews (Geller, 1990; Geller & Lehman, 1988), the countermeasures with the greatest potential for reducing DWI further are those that focus on changing the drinking behaviors or transportation decisions of individuals before they get behind the wheel of a vehicle. For example, the environmental conditions of a drinking environment can be altered to decrease excessive alcohol consumption (Geller & Kalsher, 1990; Geller, Kalsher, & Clarke, in press; Geller, Russ, & Altomari, 1986), or the servers of alcoholic beverages can be trained to recognize an alcohol-impaired customer and to intervene appropriately to reduce the probability of DWI (Geller, Russ, & Delphos, 1987; Saltz, 1987, 1989).

Intervention to prevent DWI usually requires the recognition of alcohol impairment in another person, but this is easier said than done. Langenbucher and Nathan (1983) gave measured doses

The authors are grateful for the special research assistance of Melanie Bonner and Lisa Burnette. Portions of this research were presented at the 1989 meeting of the Virginia Academy of Sciences by Michael J. Kalsher, who is currently an Assistant Professor at Rensselaer Polytechnic Institute, Troy, New York. Request for reprints should be addressed to E. Scott Geller, Department of Psychology, Virginia Tech, Blacksburg, Virginia 24061-0436.

of alcohol to target individuals, resulting in a range of individual BACs from 0.00 to 0.11, and found bartenders, police officers, and social drinkers to classify correctly the intoxication levels of only 25% of these subjects. In all but two of the correct classifications, the target subjects were sober. The more impaired a subject, the less accurate were the ratings of BAC, usually as a result of underestimations, and "at no time was a legally intoxicated target ($BAC \geq 0.10$) actually identified as such by a significant proportion of the observers" (p. 1076). McGuire (1986) found similar results at a sobriety checkpoint and concluded that accurate identification of those at risk for DWI may occur only for individuals exhibiting "gross behavioral signs of intoxication . . . such as extreme staggering, assaultive behavior, nausea, and slurred speech" (p. 85).

Russ and Geller (1986) and Streff, Geller, and Russ (1989) demonstrated that estimates of the alcohol impairment of party drinkers can be improved significantly if the partier takes a simple sobriety test (i.e., a ruler drop/reaction time task, a one-leg balance test, or backwards counting by threes). Unfortunately, the practical utility of these interventions for helping a drinker "know when to say when" is limited because it is often not feasible to expect a bar patron, partier, or even a drinking companion to perform a sobriety test upon request. The present field study investigated a more natural and easily accessible behavior than performance on a sobriety test as a potential index of DWI risk. Specifically, given that laboratory-based studies have shown fine motor skills to show significant deficits under alcohol impairment (e.g., see reviews by Carpenter, 1962, and Jellinek & McFarland, 1940), it seemed reasonable to expect that one's handwriting ability is affected by alcohol. Our empirical questions (with practical ramifications) were whether handwriting would change enough after alcohol consumption for observers to make reliable estimates of degree of alcohol impairment, and whether even the most practiced and accessible handwriting sample (i.e., one's signature) could be used as a valid index of intoxication. The handwriting samples were obtained in a natural milieu (a university

fraternity party); therefore, we assessed the feasibility of requesting handwriting samples in at least one real-world setting.

METHOD

Handwriting Samples

As they entered and departed a fraternity party at a large southeastern university, partiers signed their names to a consent form and wrote the sentence "I have read and understand the above statement." After giving these handwriting samples, each partier's BAC was obtained with a recently calibrated Alco-Sensor III breathalyzer. Sixty-one of 80 partiers who signed the consent form when entering and exiting the party had a BAC lower than 0.02 when they entered the party; thus, their signatures and sentences were selected as the handwriting samples for the present study. The mean exit BAC for these 61 partiers was 0.16, ranging from 0.0 to 0.28. A substantial number of these partiers were legally intoxicated when leaving the party (i.e., 30 subjects or 49% of the sample had BACs of 0.10 or higher).

The partiers' signatures and sentences from the entrance and exit procedures were separated and mounted on index cards (3 in. by 5 in. and 3.5 in. by 8.5 in., respectively). On the back of each card was written a code number representing the partier's exit BAC and whether the handwriting sample had been obtained before or after the party. Each entrance and exit signature or sentence pair was paper-clipped together, with random order of entrance and exit samples. A "1" was printed on the front of the first sample of each randomized pair; the second sample was labeled with a "2."

Handwriting Judges

The 28 judges of the handwriting samples were undergraduate ($n = 22$) and graduate ($n = 6$) students attending Virginia Tech; 18 were women and 10 were men with a mean age of 23 years (range, 19 to 30). As research assistants in the Center for Applied Behavior Systems (directed by the senior author), the judges had experience recording field observations of driving behaviors but

had never worked with alcoholics nor had previous research experience judging the alcohol impairment of other individuals.

Judgment Procedure

The judges attended a 1-hr session in groups of 4 to 6, during which they completed a systematic evaluation of the handwriting samples. The experimenter seated the judges at a table and told them the purpose of the study was to determine their ability to discriminate between two signatures or sentences written before and after consuming alcohol. The judges were then shown two signatures or sentences from the same partier and instructed to select the signature or sentence written after alcohol consumption. The judges recorded their responses on a standard op-scan scoring sheet that was later read directly into a computer file for analysis.

After the first judgment trial, any questions were answered by rephrasing the initial instructions. Then, all pairs of signatures or sentences were sequentially presented to the group of judges in a predetermined random order. Specifically, the first judge observed and evaluated the first pair of index cards with pre- and postparty writing samples and then passed the cards to the next judge. Then, the experimenter gave the first judge another pair of writing samples. When the second judge completed his or her evaluation of a pair of index cards, he or she passed the cards to the third judge seated on his or her right. This procedure continued sequentially until all of the writing samples were examined and scored independently by each judge. For half of the sessions the signatures were judged first, and then the sentences were evaluated. The judges were seated such that they could not see another judge's ratings, and no verbal behavior was allowed.

RESULTS

Percentage of Correct Entrance/Exit Discriminations

A percentage score was calculated for each entrance/exit sample (i.e., each pair of signatures and sentences from the same partier) by dividing the

number of judges making a correct discrimination (i.e., correctly identifying the postparty sample) by the total number of judges ($n = 28$ for each sample). The percentages of correct identifications of the exit signatures and sentences are depicted in Figure 1. The scatterplot shows that the judges' discriminations were generally more accurate for sentences ($M = 83.7\%$ correct) than for signatures ($M = 67.5\%$ correct) and were more accurate at higher BAC levels. A simple linear regression using BAC to predict the percentage of judges making a correct discrimination was calculated separately for signatures and sentences. A significant regression coefficient was obtained for both signatures, $b = 261.7$, $r^2 = 0.21$, $t(60) = 3.98$, $p < .001$, and sentences, $b = 154.8$, $r^2 = 0.11$, $t(60) = 2.71$, $p < .01$; these regression functions are drawn in Figure 1. Thus, with these linear functions one can estimate the percentage of correct signature or sentence discriminations for any given BAC. For example, using the regression equations to predict discrimination accuracy of writing samples from a partier with an exit BAC of 0.05, one estimates that 51.3% of the judges would correctly discriminate between entrance and exit signatures and 75.2% would correctly discriminate between entrance and exit sentences. On the other hand, with pre- and postparty writing samples from a partier with an exit BAC of 0.10, we estimate that 67.0% of the judges would correctly discriminate the exit signatures and 83.3% would correctly discriminate the exit sentences.

A t test indicated that the intercept for sentences (67.9%) was significantly greater than the intercept for signatures (40.8%), $t(60) = 2.00$, $p < .05$. In addition, the slope of the regression line for sentences was significantly greater than for signatures, $t(60) = 1.97$, $p < .05$, indicating that, as the BAC of the partier who gave the writing sample increased, the increase in accuracy of discriminations was greater for signatures than for sentences.

Percentage of Judges Meeting Certain Reliability Criteria

To determine the percentage of judges who were able to make reliable discriminations of the en-

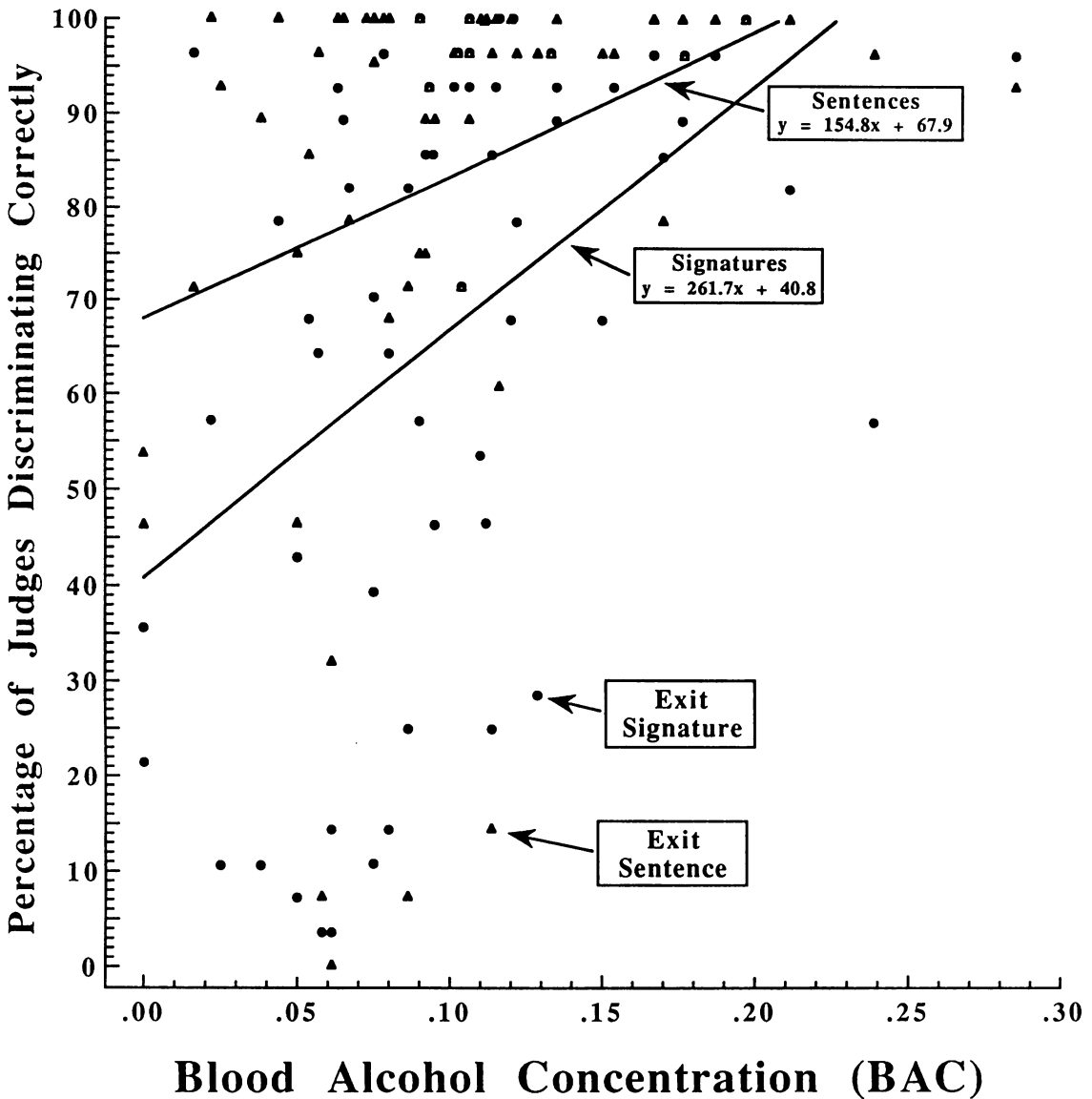


Figure 1. Percentage of judges correctly identifying the exit writing samples between each pair of entrance/exit signatures and sentences as a function of the exit BAC of the partier who gave the writing sample.

trance/exit writing samples, the writing samples were categorized according to the following six BAC levels: 0.0 to 0.029 ($n = 5$ partiers), 0.030 to 0.059 ($n = 7$ partiers), 0.060 to 0.089 ($n = 13$ partiers), 0.090 to 0.119 ($n = 18$ partiers), 0.120 to 0.149 ($n = 7$ partiers), and 0.150 to 0.300 ($n = 18$ partiers). Percentage correct scores were calculated for each judge and each BAC level for pairs of both signatures and sentences by dividing the

number of correct discriminations of the exit samples by the total number of judgments made at a given BAC level. Three reliability criteria were established (i.e., 70%, 80%, and 90% correct), and the percentages of judges who met each criterion were calculated for signatures and sentences per BAC category of the partiers who gave the writing samples. These percentages are depicted in Figure 2 for signatures and in Figure 3 for sentences.

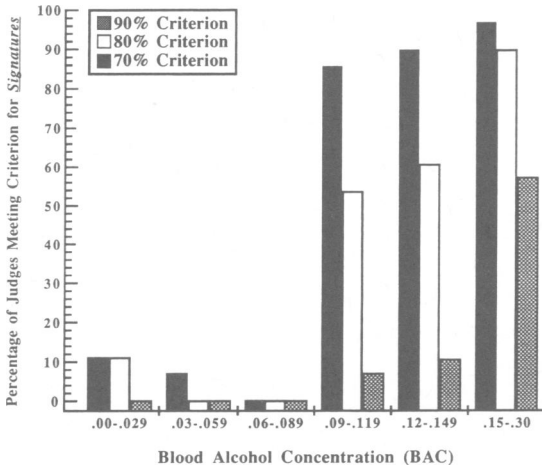


Figure 2. Percentage of judges meeting certain reliability criteria for signature discriminations (i.e., 70%, 80%, and 90% correct) as a function of the BAC category for the exit writing sample.

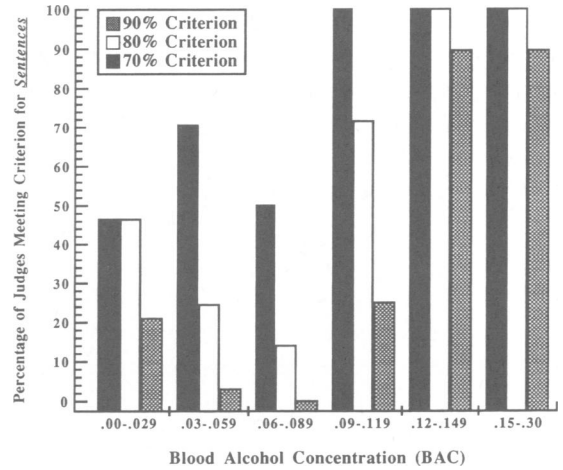


Figure 3. Percentage of judges meeting certain reliability criteria for sentence discriminations (i.e., 70%, 80%, and 90% correct) as a function of the BAC category for the exit writing sample.

Overall, a greater percentage of judges met each of the reliability criteria for sentences than for signatures; for both signatures and sentences, a greater percentage of judges met the reliability criteria at the higher BAC levels.

As shown in Figure 2, 85.7% of the judges discriminated correctly at least 70% of the exit signatures written by partiers who were intoxicated (i.e., had BACs at 0.09 or greater); when a partier's BAC reached 0.15, 89.3% of the judges reached an 80% level of correct signature discriminations. As shown in Figure 3, substantially more judges met the various reliability levels when evaluating the sentences. For example, when a partier's BAC was 0.09 or greater, all of the judges correctly discriminated at least 70% of the sentences. Furthermore, for the 25 sentences written by partiers with BACs of 0.12 or greater, all 28 judges reached the 80% correct criterion and 89.3% of the judges correctly discriminated at least 90% of these sentences. It is noteworthy that the sample of signatures and sentences obtained from partiers who were impaired but had BACs below 0.09 were not reliably discriminated by large percentages of judges. A comparison of discrimination accuracy by the 22 undergraduates versus the 6 graduate students revealed no consistent differences or trends.

DISCUSSION

The popular anti-DWI slogans, "know when to say when" and "friends don't let friends drive drunk," imply that individuals can accurately estimate their own alcohol impairment and that of others. The fact is that intoxicated individuals are often not good estimators of their own impairment (e.g., Maisto & Adesso, 1977; Russ, Harwood, & Geller, 1986), and sober individuals are even worse at judging the alcohol impairment of others (Langenbucher & Nathan, 1983). To overcome this problem, standardized performance test batteries have been developed for use in the field by trained police officers (Anderson, Schweitz, & Snyder, 1983; Burns & Moskowitz, 1977); an 11-item "Alcohol Symptom Checklist" was designed to estimate alcohol impairment among clients in a hospital emergency room (Teplin & Lutz, 1985); sobriety tests have been adapted for use in party settings (Russ & Geller, 1986; Streff et al., 1989). Although these assessment tools increase the accuracy of intoxication judgments substantially, there are a number of critical drawbacks to their use, including the need for special training on test administration and the time and inconvenience in applying a sobriety checklist or performance test.

The present experiment explored the possibility of using one's handwriting to estimate intoxication

levels, and found, in fact, that handwriting was possibly a more valid index than more inconvenient sobriety tests used with similar subjects in an analogous setting. Both Streff *et al.* (1989) and Russ and Geller (1986) found at least 95% interobserver agreement of scores on sobriety tests taken by partiers, but the best predictor of BAC (a one-leg balance test, $r^2 = 0.36$) correctly identified only 66% of the 15 legally drunk partiers (BAC ≥ 0.10), and classified 11% of the 55 nonintoxicated subjects (BAC < 0.10) as being legally drunk. In the present study, judges made correct discriminations more than 80% of the time when a sentence was written by a partier with a BAC of 0.05 or higher; when the partiers' BACs exceeded 0.10, 90% of the 28 judges correctly discriminated the exit from the entrance sentences. As predicted, intoxication was assessed more accurately from sentences than signatures, the average percentage of entrance/exit discriminations being 83.7% for sentences and 67.5% for signatures. However, when the partiers' BACs reached 0.15 ($n = 11$), 25 of the 28 judges discriminated 80% or more of the signatures correctly. When behavioral observers reach 80% agreement in their independent response classifications (or discriminations), the observation system and data are considered reliable (Kazdin, 1980).

Before deciding to substitute handwriting for more standard sobriety tests, however, one should consider that the sample of partiers in this study was limited in size, homogeneous along a number of relevant dimensions (e.g., age, education level), and reached excessive levels of BAC. In fact, of the 12 fraternity parties we have observed to date, the BACs at this particular Friday night party were substantially higher than all the others (Geller *et al.*, 1986, *in press*; Geller & Kalsher, 1990). Furthermore, it may be critical that the partiers did not know we were going to use their handwriting to assess their alcohol impairment, whereas the purpose of taking field sobriety tests is obvious. Follow-up research of handwriting as an index of alcohol impairment should evaluate the moderating effects of the subjects' knowledge that the handwriting will be used to assess alcohol impairment. Our

finding that even the most practiced writing response (i.e., one's signature) was useful in assessing alcohol impairment suggests that handwriting samples may not be completely invalidated by knowledge of purpose or opportunity to practice.

A handwriting sample is much more convenient and less intrusive to obtain than requesting performance on a field sobriety test, and it can be acquired in an unobtrusive manner without offending a patron, friend, or party guest. For example, a party host could have a "sign-in" and "sign-out" log book; a friend could observe a companion's writing behavior or ask for a writing sample; a bartender, waiter, or waitress could note a patron's writing behavior when signing a check or credit-card receipt; and a police officer could require writing behavior as part of a battery of sobriety tests. These examples, however, illustrate a critical drawback of the present study, namely that our judgments of intoxication occurred with two samples of the partiers' handwriting. Thus, it is possible (and probably likely) that the handwriting of an alcohol consumer can be used to judge BAC level reliably only when a sample of one's handwriting when sober is available (before the drinking bout). Some people may be familiar enough with a friend's normal handwriting to make an absolute judgment on a postdrinking writing sample, but this is probably rare. Thus, it may be necessary to contrive ways of obtaining "sober" samples of handwriting (as with a preparty sign-up log). For example, some bars require patrons to sign and date an entrance log whenever their IDs are checked for legal drinking age (Stone, 1989). In addition, our natural observations at university parties have always included an individual sign-in and ID check upon party entrance, and this procedure has always proceeded smoothly and conveniently with few complaints. Furthermore, we have always required some cooperative behavior of the students (e.g., asking them to take a BAC breathalyzer test and a field sobriety test) when leaving these parties, and the addition of a writing requirement was always feasible. Indeed, the 80 entrance and exit writing samples in the present study were readily obtained at the fraternity party. No one refused to write the

assigned sentence and give us a signature. Thus, it seems that an assessment of alcohol impairment with handwriting samples is quite feasible and socially acceptable in at least one common setting where the risk of DWI is often dangerously high.

This research was obviously exploratory and raises more questions than it answers. The development of reliable and valid indices for detecting a DWI risk is clearly in its infancy, especially for use in natural settings by friends, servers, and party hosts. Further research and development in this domain is urgently needed, especially given the growing emphasis on making drink servers and party hosts liable for their patrons or guests should they drive while intoxicated and cause an injury (Mosher, 1979) and the current proliferation of server/host training and intervention programs as a reaction to this "dram shop" liability (Geller et al., 1987; Saltz, 1989).

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- Received March 15, 1990*
Initial editorial decision July 8, 1990
Revision received November 17, 1990
Final acceptance December 8, 1990
Action Editor, Jon S. Bailey